

generally rectangular recesses 106. A pair of generally rectangular tabs 108 extend radially outwardly from the biasing member 90 and are accommodated by the recesses 106, and are preferably diametrically opposed to one another.

[0046] A pair of diametrically opposed, raised bumps 110 extend upwardly from the top surface of the biasing member 90. A central opening 112 of the leaf spring 20 fits snugly about the axial collar 102. A central opening 113 of the clip 92 includes flats 114 that engage flats 115 defined on the end of the x-axis extension 16. The central opening 113 of the clip 92 fits snugly over the top of the y-axis extension 16. A pair of circumferential notches 118 receive the raised bumps 110 of the biasing member 90 to define a bias position of the y-axis rotation of the rotating device interface 74, e.g., at 0°. The bumps 110 and leaf spring 118 also provide frictional rotational resistance when the rotation of the rotating device interface moves the raised bumps out of the notches 118. Artisans will, of course, understand that additional bias positions may be provided at arbitrary positions of y-axis rotation, and that the positions for positive and negative hard stops may also be altered. For example, additional notches 118 could provide additional positive and negative bias positions, which might also be called soft stop positions.

[0047] The rotating device interface 74 is fixed to rotate with a device part that is not attached to the follower 34, e.g., the flip part 26, through screws or rivets, for example, through mounting holes 122 of the radial arms 88. FIG. 5 shows an example where a fastener 124 may be used through mounting holes 122 to fasten the rotating device interface 74 to the flip part 26 thereby fixing the y-axis rotational position of the flip part 26 to that of the rotating device interface. The interface between the locking clip 92 and the leaf spring 90 provide rotational resistance, and a bias position about the y-axis when the bumps 110 engage the notches 118. Sufficient rotational force applied to the flip part 26 will move the bumps 110 out of the notches 118 to begin rotation. The rotating device interface 74 rotates with the leaf spring and the flip part 26 while the clip 92 is held rotationally in place relative to the y-axis extension 16 by the flats 114 and 115. This may be by an interference fit between the central opening 113 and the top of the x-axis extension 16, including the flats 115. The self-contained hinge may be first attached to the flip part 26, for example, and then attached to the main part 24. In an example, the knuckle 53 is attached by a fastener 125 after the rotating device interface 74 has been attached to the flip part 26.

[0048] Artisans will appreciate the self-contained nature of the FIGS. 1A-5 hinge. In addition to the general operational and structural advantages, a low part count can be considered an important feature. The hinge 10 includes a total of 9 parts.

[0049] FIGS. 6-7 illustrate another embodiment hinge 129 with a modified hinge body 130 and y-axis subassembly 132. The embodiment of FIGS. 6-8 provides the same type of operation as the hinge of FIGS. 1-5 and may, for example, provide a 0° bias position for y-axis rotation, and hard stops at +180° and -180°. The x-axis is the same as in the FIGS. 1A-5 embodiment and the hinge 129 is labeled with like reference numbers for like parts.

[0050] As illustrated in FIG. 6, the hinge body 130 includes the x-axis extension 14 and x-axis subassembly 18

of the first embodiment. A y-axis extension in this embodiment is formed by a separate shaft 131 and an extended sleeve 132 that accepts the shaft 131 in its extended axial bore 136. A seat 138 is formed by the top surface extended sleeve 128, and includes a pair of diametrically opposed, generally rectangular recesses 140 disposed therein.

[0051] The y-axis extension shaft 131 defines a lower annular seat 144 and a stop 148 having a predetermined arc length, such as 90°. The stop 148 cooperates with a stop 149 on a stop collar 150, which is otherwise free to rotate relative to the seat 144. An internal fixed feature (not shown in FIGS. 6 and 7) of the bore 136 at the lower part of the body 136 defines a stop that interfaces with the stop 149 of the stop collar 150 to limit its rotation. A comparable feature is illustrated in FIG. 9, where the stop 198 is an internal fixed feature. A rotating device interface 151 has central cavity 152 and a bar 153 that engages slots 154 to fix the relative rotational position of the rotating device interface 151 and the 131.

[0052] During y-axis rotation in one direction, the bar 153 will eventually cause the stop 148 to push the stop 149 to its rotational limit where it engages an internal fixed feature of the body 130. When rotation is reversed, the bar will eventually cause the stop 148 to push stop 149 from an opposite side and push it into the opposite side of the internal fixed feature. In this manner, a negative and positive rotational stop may be defined, for example of +/-180°.

[0053] Diametrically opposed radial arms 154 each include a mounting hole 156 that accepts a fastener for attaching to a flip part 26 as in the FIGS. 1A-5 embodiment. An annular flange 160 includes an underside with a pair of diametrically opposed notches (not shown) to cooperate with a leaf spring biasing member 162, which has bumps 164. The bumps 164 along with the notches in the underside of the flange 160 provide a bias position, e.g., 0°, for the rotating device interface in a like manner to the bumps 110 and notches 118 of the FIGS. 1A-5 embodiment. Tabs 166 extend radially from the apexes of the biasing member 162, and are configured to be held within the recesses 140 to fix the rotational position of the leaf spring 162. A locking clip 170 locks into an annular groove 172 of the shaft 131 to hold the y-axis assembly together.

[0054] Artisans will appreciate the self-contained nature of the FIGS. 6-7 hinge. In addition to the general operational and structural advantages, a low part count can be considered an important feature. The hinge 129 includes a total of 10 parts.

[0055] FIGS. 8-9 illustrate another preferred embodiment hinge 178. The hinge includes a body 186. The x-axis subassembly is similar to the previous embodiments, but includes a modified follower 188 that defines a radially extending device interface 189 that rotationally fixes the follower, for example, in a knuckle of the main part 24 of the handheld device. Remaining parts of the x-axis assembly have been labeled with the reference numbers used in the previous embodiments. A y-axis subassembly 190 is different than in the other embodiments, but provides similar controlled rotation about the y-axis.

[0056] The y-axis subassembly 190 includes a rotating device interface 192 that will rotate about the y-axis with the flip part of a handheld device. The rotational position of the